Use of Modeling Tools for Documenting and Development of Advanced Communication Systems and Import of PNM Use Cases

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Presentation Overview

- Background on Models and Tools For Advanced Systems
- The Import Process for PNM Use Cases
- Background on NIST Knowledge Base Development

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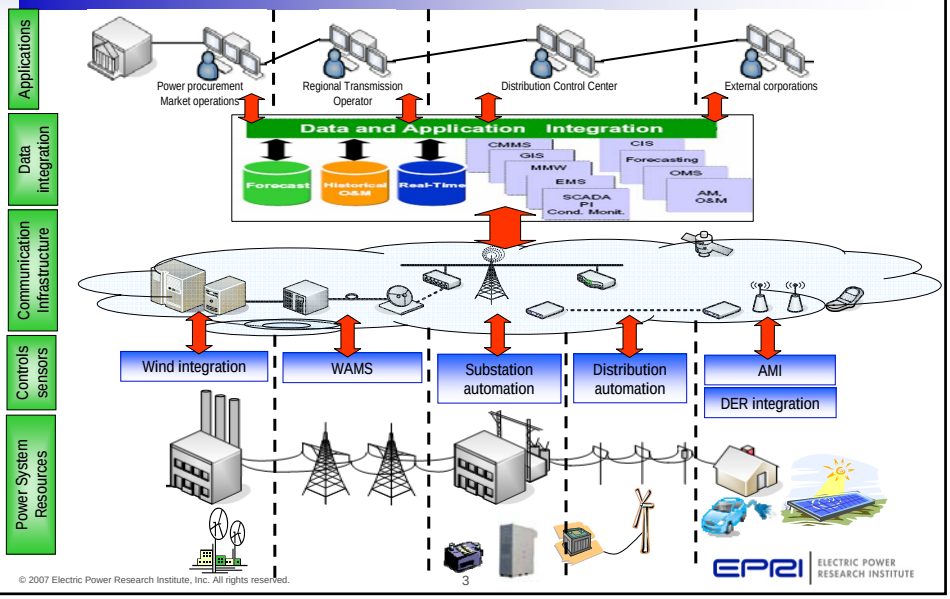
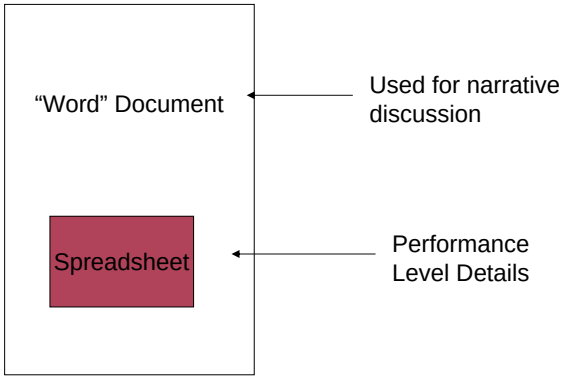
Next Generation of Systems Will Be More Complex and More Challenging to Specify, Document and Manage



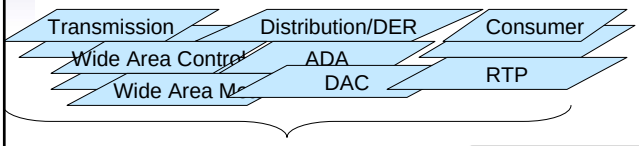
Why Use a Model and Tools?

- Systems are Becoming More Complex
- Scale and Scope of Next Generation Equipment
  - Thousands to Millions of Pieces of Field Equipment
  - Diverse Physical Media
  - Equipment Supplied by Multiple Providers
  - More Sophisticated Control and Management
- Need to Manage and Document Systems:
  - Initial Requirements and Designs
  - Life Cycle Management
- Open Standards Drives Need for Well Managed Equipment Interfaces and Integration

IntelliGrid Requirements Development: Use of a "Domain Template"



Conversion from Requirements to A Model

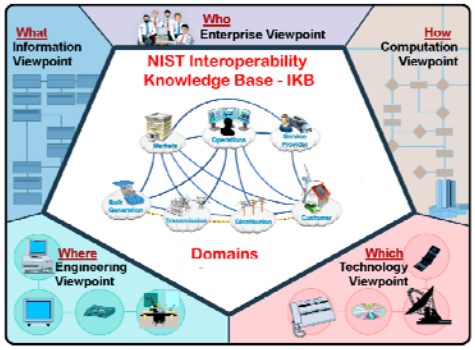


"Use Case Templates"

Import Word Templates into the CASE Tool

Create an industry model

Computer Aided Systems Engineering Tool



Requirements Template Example Use Case: Customer Communications

Step 1. Develop a Narrative Description of the Application

- An expert describes in text form how a given future power engineering function is performed including the high level business and technical context.
- Narrative focuses on the necessary distributed computing needs/requirements of the function
- Includes diagrams that can be understood by the stakeholder communities..power engineers, rate administrators etc.

Requirements Template Step *2. Identify the Actors*

- From the narrative, determine the key players, or ***Actors (devices, people, systems).***
- Name the actor and describe what it does in tabular form

1.5 Actor (Stakeholder) Roles

Grouping (Community)		*Group Description*
Actors Functioning from Customer Premises		*Actors that perform their specific functions from the premises of the Customer.*
Actor Name	*Actor Type (person, device, system etc.)*	*Actor Description*
Customer Energy Management System	System	CEMS. Customer owned premise system which interfaces with the Home Area Network and the AMI Premise Interface to provide services for load management and distributed generation. Additionally, may provide the Customer ability to control Customer owned equipment independent of the AMI.
Customer	Person	Residential or small business energy user that has a contract with the utility to receive electrical service from the utility and have a meter installed (possibly an AMI Meter). The Customer may or may not participate in programs provided by the utility including pricing events, load control or distributed generation.
AMI Premise Interface	System	The AMI Premise Interface is one of the communications radios that could be "under glass" of the AMI Meter. (There are two radios built in to the AMI Meter. One is for the AMI System and is a longer range radio. The other is for the AMI Premise Interface and it has a smaller range.) This is the communication resource to the Inverter and the Home Area Network (if available).

3. Identify the Information Exchanged between Actors

- What information do the actors exchange?
- Focus on exchanges that may cause communications problems.

Information Object Name	*Information Object Description*
PNM Solar PV Incentive Program Application	Application available on the PNM Website for the Customer to complete when they are interested in enrolling in the Solar PV Incentive Program.
Approval of the PNM Solar PV Incentive Program Application	Approval of the Customer Application for the Customer to complete when they are interested in enrolling in the Solar PV Incentive Program.
Installation Phase	Installation phase of the Customer PV System.
Completed PV Installation	Completion of the installation of the Customer PV System.
Customer PV Installation Information	Equipment and Account Information for the Customer PV Installation

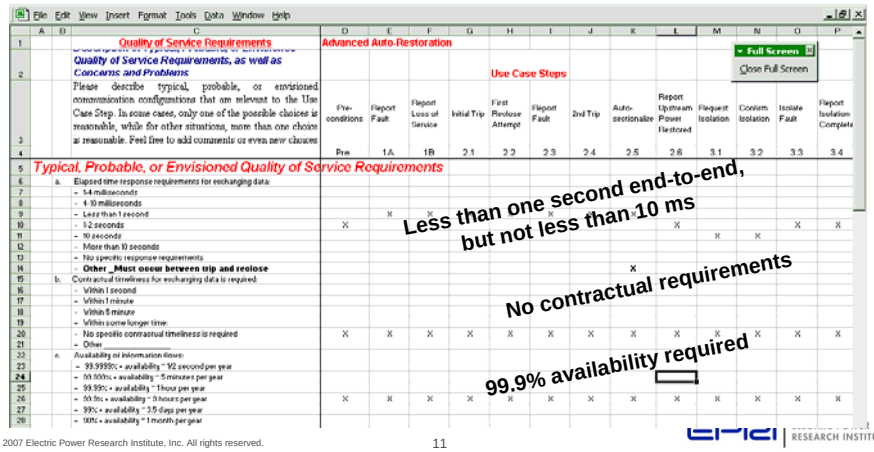
Example Use Case: Meter Reading
4. Define Steps

- What happens, and in what order? Steps are numbered.
- References the actors and the information
- Formal, rigorous, ***machine-readable*** description of the narrative

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.1	Customer indicates the desire to begin the process with PNM to install a Customer owned PV System that will be tied into the PNM electric grid.	Customer	Submits PNM Solar PV Incentive Program Application	Customer completes the PNM Solar PV Incentive Program Application available from the PNM website and submits PNM Solar PV Incentive Program Application to the PV Program Manager.	Customer	PV Program Manager	PNM Solar PV Incentive Program Application		
1.1.1	PV Program Manager reviews the PNM Solar PV Incentive Program Application of the Customer.	PV Program Manager	PV Program Manager reviews the PNM Solar PV Incentive Program Application of the Customer	PV Program Manager reviews the PNM Solar PV Incentive Program Application of the Customer and the potential DG percentage threshold for the feeder in question.	PV Program Manager	PV Program Manager	PNM Solar PV Incentive Program Application		

Example Use Case: One Way AMR
5. Identify Architectural Issues

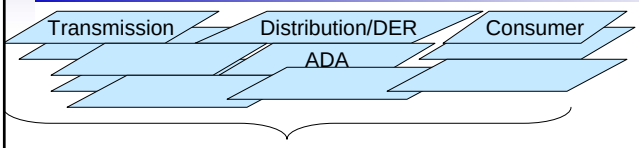
- For each step, mark multiple-choice X's regarding configuration, quality of service, security and data management
- A ***machine-readable*** rating of qualitative values.



Unified Modeling Language

- A Standardized Form of Graphically Representing System Processes
- Standardized by the Object Management Group
- Developed out of the Software Industry
- A way to represent applications to complement text

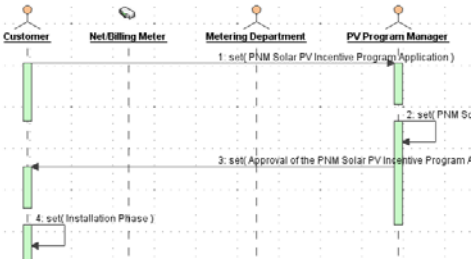
Import Requirements into System Model



"USE CASE Templates"

Import Word Templates into the CASE Tool

Create a graphical rendering (UML)



Computer Aided Systems Engineering (CASE) Tool

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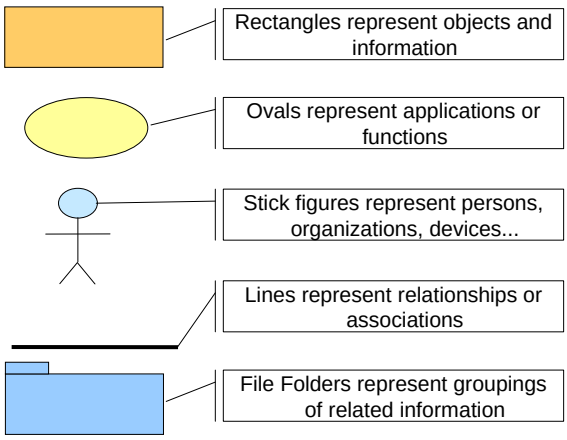
Easy To Draw Diagramming: the Unified Modeling Language



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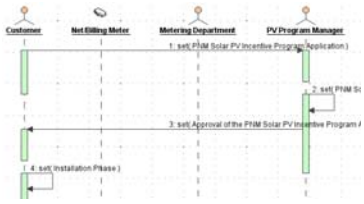
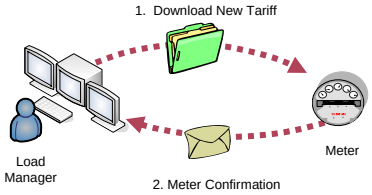
Comparison of stick figure vs. graphic diagrams

Stick Figure version



Graphics version



Introduction to UML Diagrams

Introduction to IntelliGrid Diagrams

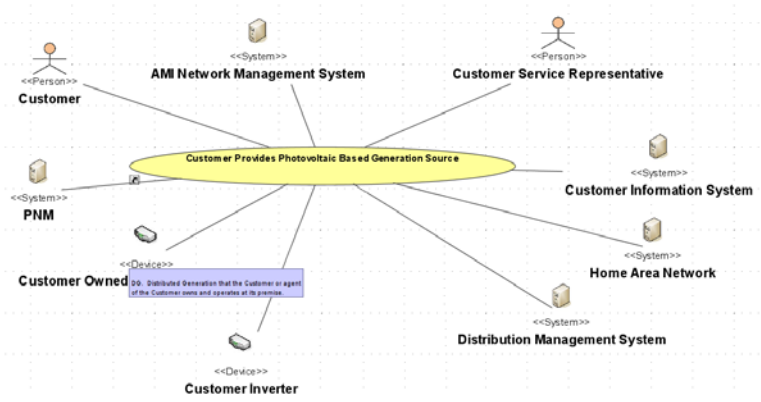
Who: aUseCaseDiagram — A Use Case Diagram presents an example of an application or function. It is used to illustrate "who" is involved in the application(s).

What: AClassDiagram — A Class diagram shows the "what" of architecture.

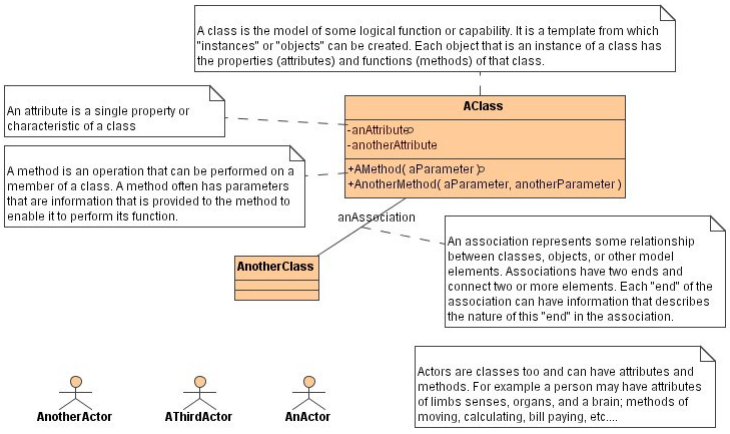
aSequenceDiagram — A sequence diagram also illustrates the "how" an application is implemented. Sequence diagrams focus on the flow of messages relative to the passage of time.

How: anActivityDiagram — An activity diagram illustrates a business process. It is the "how" a function is logically implemented. I shows the step by step flow of activities between participants in the process, as well as, the pieces of information exchanged and what causes the transition from one step to the next.

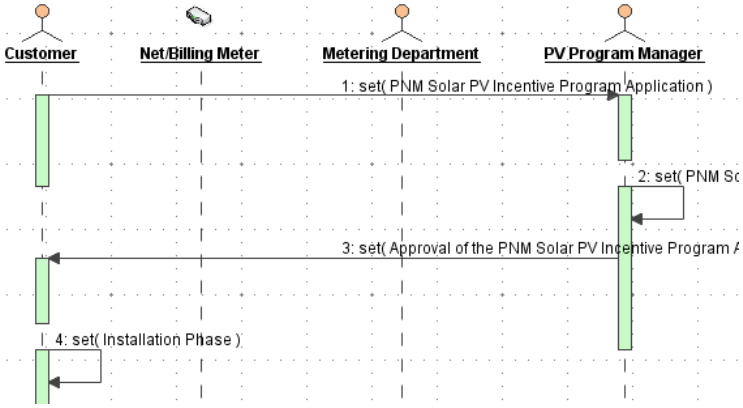
Use Case Diagram : Who is involved… Customer Provides PV Based Generation Source Example



A Class Diagram Shows the Composition of What a Class or Object Is



A Sequence Diagram Shows How a Use Case Works



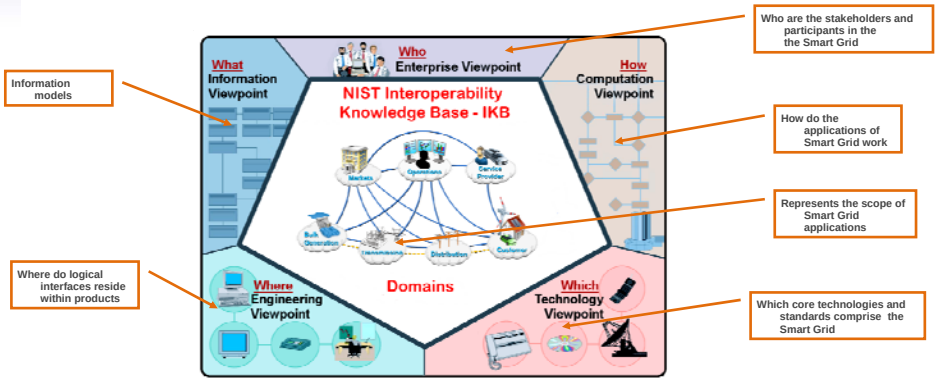
Customer Provides PV Based Generation Source example - Steps Show How it is implemented

Normalization Process Examples

- Actors Before
  - Electric Meter
  - Line Meter Device
  - Meter Device
  - MeterDevice
  - Meters
  - MeterDataManagementAgent
  - Meter Data Management Agents
  - MDMA
  - MDMAMetering

- Actors After
  - Meter
  - MeterDataManagementAgent (MDMA)

Graphic of Smart Grid IKB Model



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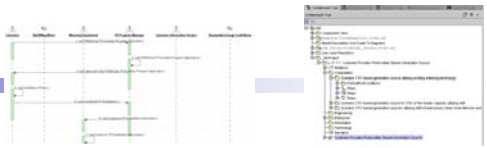
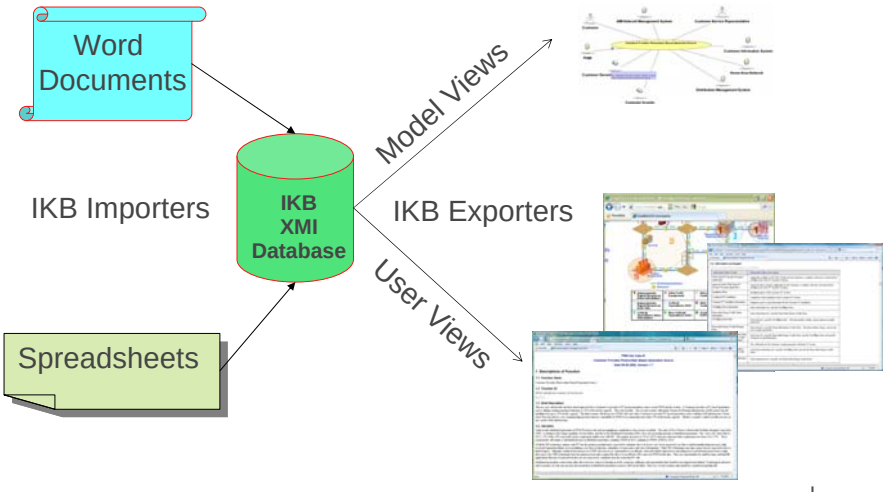
Import Process Summary





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Knowledge Base Definition

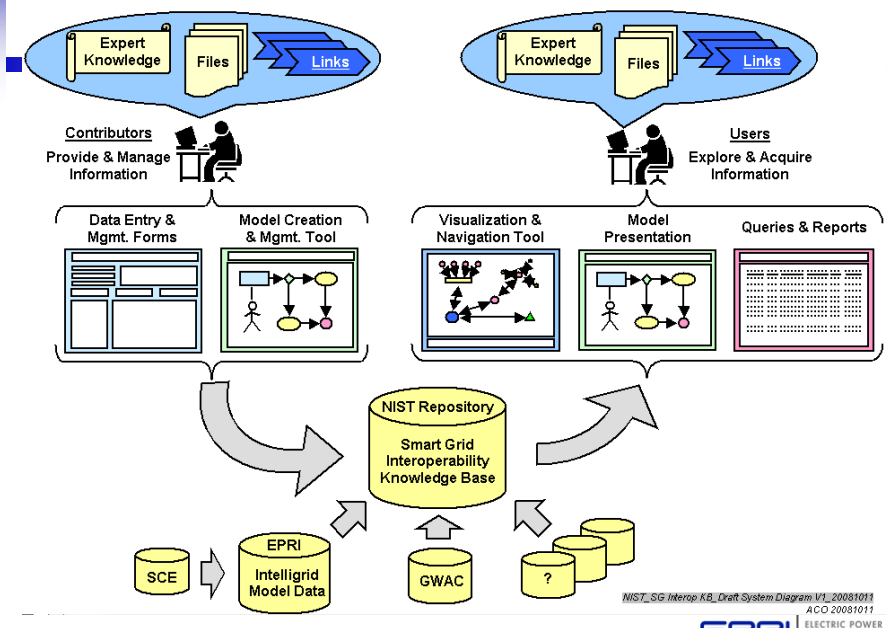
- A centralized repository of information, a database of knowledge about a particular topic.
- May be Machine Readable and/or Human Readable
- Not a Static collection of information but dynamic

- For the Smart Grid:
  - Information on Use Cases and Requirements
  - Status of Standards Development
  - Ontology/Glossary of Standardized Terms Traceable to Standards
  - A tool for graphical renderings of content

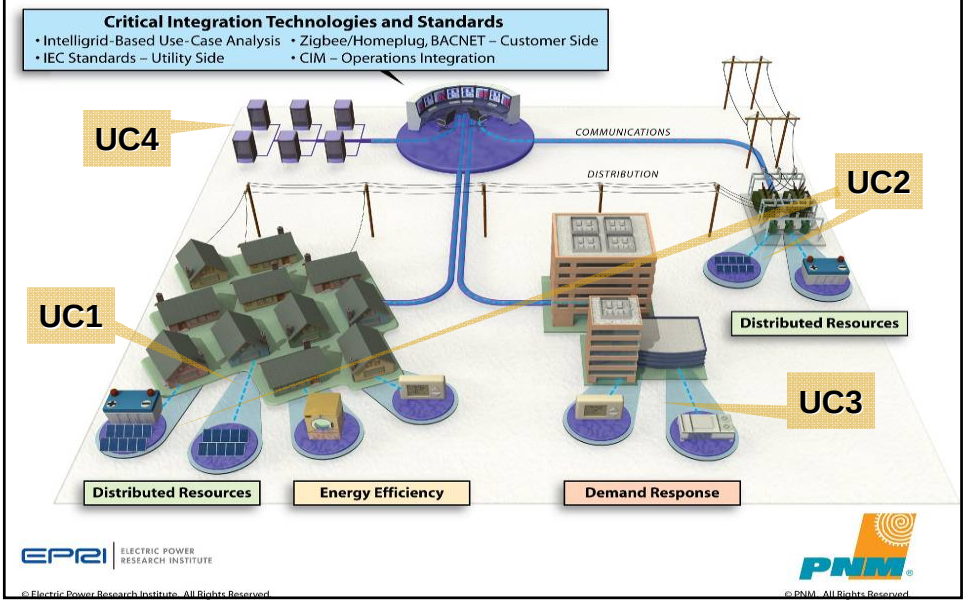
Project Context and Background

- "NIST Plans to develop a publicly-accessible interoperability knowledge base that will be the repository of information necessary to do standards assessments*"
- EPRI Project Goals:
  - Assist Technical Integration of EPRI's Prior Work into the NIST Knowledge Base
  - Develop Methods to Import Use Case "template" Information into the Knowledge Base Model

*Patrick Gallagher, Ph.D., Testimony Before the Committee on Energy and Natural Resources US Senate



Questions?



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PNM